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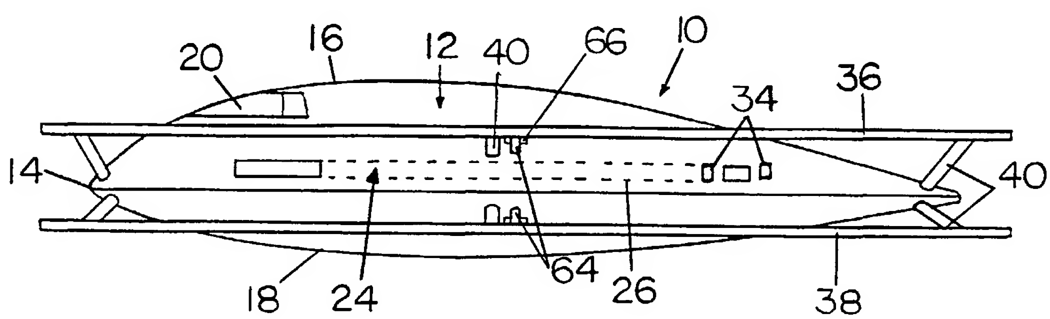

(57) Abstract: An aircraft is provided having an airfoil shaped housing so as to provide lift when propelled in a forward direction at a speed greater than a stall speed of the aircraft. A forward drive system including plural jet engines (24) are mounted on the housing and arranged to generate forward thrust to drive the housing in the forward direction. A rotary propulsion system (36, 38) is also provided in the form of circular rings mounted about the housing having vanes which are arranged to provide lift to the housing when rotated. The forward drive system is coupled to the rotary propulsion system by a mechanical drive mechanism to selectively drive rotation of the rotary propulsion system by the forward thrust of the forward drive system. A thrust reversing mechanism is arranged to divert a portion of the forward thrust to rearward thrust for vertical take-off of the aircraft.

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AIRCRAFT

FIELD OF THE INVENTION

The present invention relates to an aircraft and more particularly to an aircraft arranged for vertical take-off.

BACKGROUND

Conventional aircraft rely on forward thrusters and wing design to generate the required lift for take-off and to maintain cruising altitude. These aircraft however require more powerful engines and wing sizes of greater thickness and size for landing and take-off than are required to maintain the aircraft's speed and altitude at normal cruise height. The engines are thus heavier and the wings create more drag than is necessary to sustain the aircraft at cruising altitudes. In addition, conventional aircraft require very strong and relatively heavy landing gear in order to sustain the forces involved in landing the aircraft at their required landing speeds. The excessive weight of these components results in poor efficiency during normal flight of the aircraft, and reduces load carrying capacity.

Various known modified aircraft have been arranged for vertical take-off to avoid the problems normally associated with taking off and landing of conventional aircraft. These modified aircraft generally use separate engines for vertical and horizontal thrust or require complex mechanisms to generate both the vertical and horizontal thrust and maintain directional stability. These known designs are thus generally complex and costly and result in reduced efficiency and economy.

United States Patent No. 5,039,031 to Valverde provides an aircraft including forward thrusting jet engines and a fan lifting assembly including vanes for providing lift to the aircraft when rotated. The fan lifting assembly however requires a complex drive system connecting the assembly to the jet engines for

operation of the assembly. The drive system requires operation of either the forward thrust of the jet engines or the fan lifting assembly. When operating the fan lifting assembly, the aircraft of Valverde is unable to compensate for the forward thrust from the jet engines and is therefore not suitably arranged for only vertical lift as desired for vertical take-off of an aircraft.

SUMMARY

According one aspect of the present invention there is provided an aircraft comprising a housing having a forward leading edge and top and bottom surfaces extending rearwardly from the leading edge and being generally in the shape of an airfoil so as to provide lift to the housing when the housing is propelled in a forward direction at a speed greater than a stall speed of the housing and a forward drive system mounted on the housing arranged to generate forward thrust to drive the housing in the forward direction at a speed greater than the stall speed, wherein the improvement comprises:

a rotary propulsion system having vanes which are arranged to provide lift to the housing when the rotary propulsion system is rotated;

a mechanical drive mechanism coupled to the forward drive system and being arranged to selectively drive rotation of the rotary propulsion system, the mechanical drive mechanism being driven by the forward thrust of the forward drive system; and

a thrust reversing mechanism coupled to the forward drive system and being arranged to divert a portion of the forward thrust to rearward thrust acting on the housing in a direction opposite to the forward direction.

In the present invention the forward drive system directly provides forward thrust for efficient normal cruising altitude flight, while the rotary propulsion system coupled thereto provides the necessary lift at speeds less than stall speed, as required for take-off and landing for example. In this arrangement

the initial power or forward thrust of the forward drive system can be devoted entirely to providing power for lift off using the rotary propulsion system and thus is not immediately employed to build up air speed and overcome friction for take-off. The engines of the forward drive system are thus not required to be any larger or more powerful than appropriate for sustaining flight at normal cruise height. This also permits the airfoil shape of the housing to be reduced to minimize drag, and eliminates the excessive drag from wings which are larger than necessary for normal cruise on conventional aircraft. The rotary propulsion system may further be used when landing the aircraft to permit landing at very slow or even zero speeds, eliminating the need for very strong and heavy landing gear, resulting in a reduction of weight and a more efficient aircraft. The aircraft according to this design may thus be considerably more economical in fuel consumption than conventional aircraft currently in use.

The thrust reversing mechanism is preferably arranged to balance the rearward thrust with the forward thrust generated the forward drive system to permit vertical take-off of the aircraft.

The forward drive system preferably includes a pair of jet engines mounted laterally spaced apart from one another on opposing sides of the housing. The mechanical drive mechanism is preferably coupled to both of the jet engines so as to be arranged to be driven by forward thrust from each of the jet engines. Each of the jet engines may include a respective thrust reversing mechanism mounted in selective communication therewith.

The mechanical drive mechanism preferably comprises a turbine arrangement mounted in communication with exhaust from the forward drive system and being arranged to be driven by the forward thrust of the forward drive system, the turbine arrangement being arranged to drive the rotary propulsion system.

The turbine may be arranged to be selectively engaged with the rotary propulsion system for controlling operation of the rotary propulsion system.

When the forward drive system comprises a plurality of jet engines, the mechanical drive mechanism may be driven by only some of the jet engines.

The rotary propulsion system is preferably mounted externally of the housing. In this arrangement, the rotary propulsion system may comprise annular propulsion elements supported for rotation about the housing, each of the annular propulsion elements supporting a plurality of the vanes thereon.

A first annular propulsion element may be supported for rotation above the housing with a second annular propulsion element being supported for rotation below the housing. The first and second annular elements are preferably supported for rotation in opposing directions about a common axis.

The vanes are preferably pivotally supported on the respective annular elements for pivotal movement between various vane angle positions.

The vanes are preferably supported on respective axles which are substantially centred between respective free ends of the respective vanes.

For reduced drag during normal cruising flight, the vanes are preferably pivotally supported on the rotary propulsion system for pivotal movement into a disengaged position in which the vanes lie substantially parallel to the forward direction.

The forward drive system may include a directional control system arranged to redirect the forward thrust of the forward drive mechanism. The directional control system preferably comprises a series of adjustable baffles supported in communication with exhaust from the forward drive system.

When the forward drive system extends internally through the housing from inlets at a forward end of the housing to exhaust outlets at a rear end of the housing, the baffles are preferably supported internally of the housing

adjacent the exhaust outlets.

At least one horizontally oriented baffle and at least one vertically oriented baffle are preferably provided for steering the aircraft both up and down as well as side to side.

In addition to the use of baffles as part of the directional control system of the forward drive, a rudder and an elevator are also preferably included as an additional means of controlling the direction of the aircraft. The rudder and the elevator are particularly useful as a safety measure to provide sufficient flight control in the event that one or more of the engines of the forward drive system become inoperable.

The thrust reversing mechanism is preferably movable between a deployed position externally from the housing in communication with exhaust from the forward drive system and an undeployed position fully contained within the housing.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings, which illustrate exemplary embodiments of the present invention:

Figure 1 is a top plan view of a first embodiment of the aircraft.

Figure 2 is a front elevational view of the aircraft of Figure 1.

Figure 3 is a side elevational view of the aircraft of Figure 1.

Figure 4 is a partly sectional top plan view of a portion of the aircraft of Figure 1.

Figure 5 is a sectional view along the line 5-5 of Figure 1.

Figure 6 is a side elevational view of the vanes of the rotary propulsion system.

Figure 7 is a top plan view of the thrust reversing mechanism in a deployed position.

Figure 8 is a front elevational view of an alternative embodiment of the aircraft wherein the engines are mounted externally below the housing.

Figure 9 is a front elevational view of yet a further embodiment of the aircraft.

DETAILED DESCRIPTION

Referring initially to Figures 1 through 7, there is illustrated a first embodiment of an aircraft generally indicated by reference numeral 10. The aircraft 10 is generally arranged for a first vertical take-off stage of flight and a second normal cruising stage of flight.

The aircraft 10 includes a housing 12 having a forward leading edge 14 at a front end thereof. The housing 12 further includes a top surface 16 and a bottom surface 18 extending rearwardly from the leading edge 14 to a rear end of the housing such that the housing defines a generally airfoil shape in cross section for providing lift to the housing when the housing is advanced in a forward direction at a speed greater than a stall speed of the aircraft. The housing 12 is generally circular in shape as viewed from above having a cockpit 20 therein at a raised front end of the housing.

Forward thrust is provided by a pair of spaced apart jet engines 24 which are aligned with a normal forward direction of flight. The jet engines are spaced laterally apart and balanced about a central longitudinal axis of the housing to provide stability to the aircraft. Each jet engine 24 is located within an integrally mounted duct 26 which extends through the housing from an inlet adjacent the front end of the housing to an outlet adjacent the rear end of the housing to communicate air through the duct in flight. The inlets of the duct are broader and much greater in cross sectional area than the remainder of the duct to ensure a sufficient amount of air is drawn into the duct during normal flight.

To provide added stability during landing and take-off as well as

steering during normal flight, a directional control system is provided which is arranged to redirect the forward thrust of the jet engines as desired during operation of the aircraft for steering. The directional control system includes a set of vertical baffles 28 and horizontal baffles 30 which are located within an exhaust portion of each duct 26 downstream from the jet engines 24. The vertically oriented baffles 28 are located upstream in front of the horizontal baffles 30 with both baffles being located wholly within the duct 26, integrally within the housing. The baffles are normally aligned so as not to obstruct the flow of exhaust through the duct however as required for manoeuvring and stability, the baffles 28 and 30 may be pivoted about their respective axes as desired to control the flight of the aircraft. The baffles thus act as a directional control of the aircraft by redirected forward thrust of the jet engine exhaust.

A thrust reverser mechanism 32 is mounted integrally within the housing adjacent the outlet of each duct 26 for communication with a respective one of the jet engines. A series of respective access doors 34 in the housing permit the thrust reverser mechanisms 32 to be drawn in and out of the housing between a deployed position as seen in Figure 7 for engaging the jet engine exhaust as desired and an undeployed position in which the mechanisms 32 are contained wholly within the housing and the doors 34 are closed flush with an outer surface of the housing.

The thrust reverser mechanisms are thus arranged to reduce or completely eliminate the forward thrust of the jet engines during landing and take-off while being retracted during normal cruising. As illustrated in the deployed position in Figure 7, the thrust reversing mechanism 32 includes a pair of shields 32b which are supported by a linkage 32c in communication with forward thrust of the exhaust of the jet engines. The position of the shields is adjustable using the linkage 32c to divert any desired amount of forward thrust to rearward thrust

acting on the housing in a direction opposite to the forward direction of normal flight of the aircraft and to balance the forward and rearward thrust when vertical take-off is desired.

A rotary propulsion system is provided externally from the housing in the form of upper and lower annular propulsion elements 36 and 38 having vanes 39 therein to provide lift to the aircraft during take-off and landing when the annular elements are rotated. The annular elements 36 and 38 are mounted one above the other concentrically about the housing in substantially parallel alignment with a direction of normal cruising flight of the aircraft. The upper annular element 36 is thus located generally above the housing adjacent the top side of the housing while the lower annular element 38 is located generally below the housing adjacent the bottom side of the housing. The upper and lower annular propulsion elements 36 and 38 are arranged to rotate in opposing directions about a generally upright common axis to generate vertical thrust at take-off and landing of the aircraft as required. The upper and lower annular propulsion elements are appropriately spaced from one another and the from the housing so as to be positioned for efficient lifting.

A plurality of circumferencially spaced support members 40 rotatably support the annular propulsion elements 36 and 38 on the housing 12. Each support member 40 is anchored and an inner end on the housing on a corresponding top or bottom surface thereof to extend radially and outwardly from the housing. A coupling 42 located at an outer free end of each support member 40 rotatably supports the respective annular propulsion element thereon.

Both the upper and lower annular propulsion elements 36 and 38 have first and second tracks 44 and 46 located circumferencially thereon. The first track 44 is located on a bottom side of each annular propulsion element for receiving a set of first wheels 48 therein to support the annular propulsion

elements on the housing when the annular propulsion elements are not arranged to provide lift. The second track 46 is located on the top side of each annular propulsion element for receiving a set of second wheels 50 therein to support the housing on the annular propulsion elements when the annular propulsion elements are rotating to provide lift to the housing. Each coupling 42 includes a greater number of second wheels 50 than first wheels 48 to support the greater forces required to support the housing thereon. Each coupling 42 also includes shielding 52 which extends over the first and second wheels to provide an aerodynamic covering to the coupling.

The plurality of vanes 39 are circumferentially spaced about the respective annular propulsion elements 36 and 38. Each vane 39 is pivotally mounted on a respective axle 56 for adjusting a relative angle of the vanes from horizontal between numerous vane angle positions.. The vanes 39 are balanced about the respective axles 56 to define a pair of equally extending and diametrically opposed free ends extending from the axle which is centred between the free ends. The axles 56 are aligned to extend radially outward from the housing. A relative angle of the vanes is thus adjustable using a gearing system to control the deflection in stages such that selection of an appropriate angle of attack will cause lift to the housing when the annular propulsion elements are rotated. In an undeployed position, the vanes are substantially parallel with the annular propulsion elements and the normal direction of flight so as to provide minimal drag during normal cruise flight.

Rotation of the annular propulsion elements is powered by a mechanical power take-off drive mechanism 60 associated with each jet engine 24. Each power take-off drive mechanism 60 is located within the duct 26 in communication with the exhaust air stream of the respective jet engine 24 to produce rotation of an output shaft 62 of the drive mechanism when the

respective jet engines are ignited and are providing forward thrust. Power is drawn from the output shafts to drive rotation of the upper and lower annular propulsion elements 36 and 38. The power take-off drive mechanism includes a drive turbine 63 located in the duct 26 so as to be driven to rotate by the jet engine exhaust and a drive train for rotating the output shaft 62 in response to rotation of the drive turbine.

A drive shaft 64 is provided for coupling between each engine and the respective upper and lower annular propulsion elements. The drive shafts 64 are coupled to respective gear boxes 66 located on the respective upper and lower annular propulsion elements 36 and 38. A clutch mechanism 68 is coupled between the output shaft 62 of each engine and the respective drive shafts 64 of the upper and lower annular propulsion elements 36 and 38 for selectively engaging the power take-off drive mechanism 60 with the upper and lower annular propulsion elements 36 and 38 respectively, thus selectively driving rotation of the annular propulsion elements.

The clutch mechanism 68 is generally engaged when the speed of the aircraft in a forward direction is less than the stall speed of the housing and lift from the rotary propulsion system is required for take-off or landing. The clutch mechanism 68 is generally disengaged during normal flight when the forward speed of the aircraft is greater than the stall speed of the housing and the rotary propulsion system not required for additional lift.

The jet engines 24 are arranged to have an appropriate power output sufficient to rotate the upper and lower annular propulsion elements 36 and 38 at a speed to provide the necessary lift for take-off in a first stage of flight, while also being sufficient in power to move the aircraft in a forward direction greater than a stall speed of the housing during a second stage of flight. During the second stage of flight the vanes are preferable undeployed and returned to a

position parallel to a line of motion of the annular propulsion elements 36 and 38. The annular propulsion elements may thus be brought to a stationary position relative to the aircraft housing for diverting the power of the engine entirely to moving the aircraft in the forward direction. The necessary lift is thereafter provided by the aircraft's airfoil shape.

Particularly during the low speeds at take-off and landing, horizontal and vertical stability and control are provided by the vertical and horizontal baffles 28 and 30. The thrust reverser mechanisms 32 can be deployed and undeployed in stages as needed to provide further control in this regard. The thrust reverser mechanisms 32 are arranged to ensure that the engines thrust can be restrained as required to moderate the aircraft's forward motion during take-off and landing.

The deployment and subsequent undeployment of the vanes is accompanied by a relatively small rotation of their axles by the movement of gears 69a attached thereto. The gears 69a are activated by smaller rings 69b within the main upper and lower annular propulsion elements 36 and 38 which in turn are powered by several small electric motors 69c. The electrical supply to these motors is provided by rolling connections from the aircraft's housing in several locations to ensure continuity of electrical supply. The electrical motors are activated by radio signals from the aircraft's cockpit.

Since the vanes are balanced for and aft on their respective axles, deployment of the vanes does not require substantial power. Deployment of the vanes in flight and in preparation for landing, however must be done in stages to avoid excessive pressure on the vanes. Deployment in flight will produce some lift and reduce stall speed and will take place prior to the circular annular propulsion elements themselves being brought into motion by the application of power from the aircraft's engines. After deployment of the vanes and the activation of the upper and lower annular propulsion elements 36 and 38 in

preparation for landing, lift will increase as more power is applied to the rotary propulsion system and the forward speed of the aircraft can be reduced as desired by the deployment in stages of the thrust reverser mechanisms 32. The aircraft 10 is thus arranged for vertical take-off and landing while having jet engines 24 suitably and efficiently sized for forward thrust during normal cruising flight rather than requiring excessive power output therefrom for take-off and landing.

An alternative arrangement is illustrated in Figure 8 wherein there is provided a cabin 70 extending longitudinally along a bottom side of the housing 12. This arrangement is particularly useful for passenger aircraft or for the transportation of cargo. The housing also differs from that of the first embodiment in that there is provided a pair of externally mounted jet engines 72 mounted spaced apart on the bottom side of the housing in place of the integrally mounted jet engines. The engines 72 operate similarly to the engines 24 described above for selectively driving rotation of the annular propulsion elements of the rotary propulsion system.

An auxiliary jet engine 73 is mounted centrally on a top side of the housing which can be dedicated entirely to providing forward thrust. Alternatively, in a preferred arrangement, the auxiliary engine provides the sole power to the mechanical power take-off drive mechanism which drives the rotary propulsion system. The main jet engines 72 thus remain balanced while being dedicated solely to providing forward thrust to the aircraft.

When the auxiliary jet engine 73 is provided, the thrust reversing mechanism is preferably mounted solely in communication with the auxiliary engine while still being able to divert enough forward thrust to rearward thrust to balance the forward motion of the aircraft for vertical take-off. The thrust reversing mechanism in this instance is similarly movable between the deployed

and undeployed positions. Again, the main jet engines 72 in this instance remain balanced in terms of the amount of forward thrust provided to the aircraft regardless of the operation of the thrust reversing mechanism.

A further variation of the aircraft 10 is illustrated in Figure 9 wherein the jet engines 72 are similarly mounted externally from the housing spaced apart on a bottom side of the housing 12. Directional control of the vehicle in this arrangement however is accomplished by an adjustable rudder 74 and an adjustable elevator 76 similar to those on conventional aircraft in place of the baffles found in the first embodiment. The rotary propulsion system operates similarly to that of the first embodiment.

In a preferred embodiment, both the baffles of the first embodiment and the rudder 74 and elevator 76 arrangement are provided on the aircraft together for added safety. In this instance, should the engines 72 of the forward drive system fail for any reason, flight of the aircraft can still be controlled by the rudder 74 and elevator 76 arrangement. Alternatively, when the engines are operating, the baffles are sufficient to control flight of the aircraft regardless of the condition of the rudder and elevator.

Other variations to the housing may also be incorporated depending upon the intended use of the aircraft, while still making use of the arrangement wherein there is provided a pair of annular propulsion elements which are selectively driven by forward thrusting jet engines for providing lift during take-off and landing of the aircraft.

In either embodiment, the aircraft 10 is a circular disc-shaped aircraft hull, of generally airfoil shape, to which are attached two annular propulsion elements or rings. The rings contain vanes attached to the rings by axles. The vanes are balanced equally fore and aft on the axles, and can be deployed by rotating the axles of the vanes slightly to bring the vanes into an

angle of attack appropriate to provide a desired lift, when the circular rings are brought into motion.

The annular propulsion elements or rings are parallel to each other, separated by an appropriate distance, and generally aligned along the aircraft's direction of normal flight. The rings are designed to rotate in opposite directions from each other when power is applied from the aircraft's power sources. The rings are connected to the aircraft's power sources by appropriate gearing, so that the rings can be activated to rotate when desired to provide lift for the purpose of landing or taking off.

The aircraft's power sources include two jet engines located at either side of the aircraft, aligned to its direction of flight, of appropriate power sufficient to move the circular disks at a speed sufficient to provide the lift necessary for takeoff, and after takeoff, to move the aircraft to a speed above its stall speed, at which point the vanes can be undeployed and returned to a position parallel to line of motion of the rings. The rings can then be brought to a stationary position relative to the aircraft hull, the power to the rings shut off, and the engines then diverted entirely to moving the aircraft forward. The necessary lift is thereafter provided by the aircraft's airfoil shape. If additional forward thrust is desired, a third engine is placed at the back of the aircraft, unconnected with the rings, to provide further forward thrust.

Since the kind of control surfaces employed by conventional aircraft may not be sufficiently effective at the low speeds of takeoff and landing involved in some embodiments of this aircraft design, special provision to provide horizontal and vertical stability and control are used. These provisions are in the form of the horizontal and vertical baffles located in the exhaust flow of the engines. In addition, partial or complete thrust reversers are provided, which can be deployed and undeployed in stages, as shown in the attached engine

diagram, to ensure the engine's thrust can be restrained as required to moderate or completely halt the aircraft's forward motion during take-off and landing. Appropriate thrust reversers on the auxiliary third engine can eliminate the need for thrust reversers on the two side engines.

The design of the aircraft 10 lends itself in particular to two kinds of military application. In a smaller version, the aircraft can replace the ground attack helicopter currently in use. Helicopters are not particularly effective in terms of fuel consumption, since they must devote a considerable amount of energy to maintaining directional stability. They are not as fast as other jet powered aircraft, nor do they have as much range. Their advantage as attack helicopters is their ability to hover and to land and take off vertically. In the latter two characteristics, the aircraft 10 matches the helicopter, while enjoying the other advantages of conventional aircraft, for example greater fuel economy, speed, and range.

In a larger version, the aircraft 10 is capable of employment as a troop and supply carrier. The aircraft may relieve military personnel of the need to rely upon land base supply lines. The aircraft can also replace trucks which travel on the ground, for example at approximately 25 mph, and which are subject to delays by all kinds of obstacles, for example broken bridges, with a means of supply that can avoid all ground obstacles, and likely travel as much as 20 times faster. The aircraft is accordingly capable of carrying supplies for much greater distances, and by virtue of ability to land on any level stretch of ground, deliver supplies close to the scene of operations.

While various embodiments of the present invention have been described in the foregoing, it is to be understood that other embodiments are possible within the scope of the invention. The invention is to be considered limited solely by the scope of the appended claims.

CLAIMS:

1. An aircraft comprising a housing having a forward leading edge and top and bottom surfaces extending rearwardly from the leading edge and being generally in the shape of an airfoil so as to provide lift to the housing when the housing is propelled in a forward direction at a speed greater than a stall speed of the housing and a forward drive system mounted on the housing arranged to generate forward thrust to drive the housing in the forward direction at a speed greater than the stall speed, wherein the improvement comprises:

a rotary propulsion system having vanes which are arranged to provide lift to the housing when the rotary propulsion system is rotated;

a mechanical drive mechanism coupled to the forward drive system and being arranged to selectively drive rotation of the rotary propulsion system, the mechanical drive mechanism being driven by the forward thrust of the forward drive system; and

a thrust reversing mechanism coupled to the forward drive system and being arranged to divert a portion of the forward thrust to rearward thrust acting on the housing in a direction opposite to the forward direction.

2. The aircraft according to Claim 1 wherein the thrust reversing mechanism is arranged to balance the rearward thrust with the forward thrust generated the forward drive system.

3. The aircraft according to Claim 1 wherein the forward drive system includes a pair of jet engines mounted laterally spaced apart from one another on opposing sides of the housing.

4. The aircraft according to Claim 3 wherein each of the jet engines includes a thrust reversing mechanism mounted in selective communication therewith.

5. The aircraft according to Claim 3 wherein the mechanical

drive mechanism is coupled to both of the jet engines so as to be arranged to be driven by forward thrust from each of the jet engines.

6. The aircraft according to Claim 1 wherein the mechanical drive mechanism comprises a turbine arrangement mounted in communication with exhaust from the forward drive system and being arranged to be driven by the forward thrust of the forward drive system, the turbine arrangement being arranged to drive the rotary propulsion system.

7. The aircraft according to Claim 6 wherein the turbine is arranged to be selectively engaged with the rotary propulsion system for controlling operation of the rotary propulsion system.

8. The aircraft according to Claim 1 wherein the forward drive system comprises a plurality of jet engines, the mechanical drive mechanism being driven by only some of the jet engines.

9. The aircraft according to Claim 1 wherein the rotary propulsion system is mounted externally of the housing.

10. The aircraft according to Claim 9 wherein the rotary propulsion system comprises annular propulsion elements supported for rotation about the housing, each of the annular propulsion elements supporting a plurality of the vanes thereon.

11. The aircraft according to Claim 10 wherein there is provided a first annular propulsion element supported for rotation above the housing and a second annular propulsion element supported for rotation below the housing.

12. The aircraft according to Claim 11 wherein the first and second annular elements are supported for rotation in opposing directions about a common axis.

13. The aircraft according to Claim 10 wherein the vanes are pivotally supported on the respective annular elements for pivotal movement

between various vane angle positions.

14. The aircraft according to Claim 13 wherein the vanes are supported on respective axles which are substantially centred between respective free ends of the respective vanes.

15. The aircraft according to Claim 9 wherein the vanes are pivotally supported on the rotary propulsion system for pivotal movement into a disengaged position in which the vanes lie substantially parallel to the forward direction.

16. The aircraft according to Claim 1 wherein the forward drive system includes a directional control system arranged to redirect the forward thrust of the forward drive mechanism.

17. The aircraft according to Claim 16 wherein the directional control system comprises a series of adjustable baffles supported in communication with exhaust from the forward drive system.

18. The aircraft according to Claim 17 wherein the forward drive system extends internally through the housing from inlets at a forward end of the housing to exhaust outlets at a rear end of the housing with the baffles being supported internally of the housing adjacent the exhaust outlets.

19. The aircraft according to Claim 17 wherein there is provided at least one horizontally oriented baffle and at least one vertically oriented baffle.

20. The aircraft according to Claim 1 wherein the thrust reversing mechanism is movable between a deployed position externally from the housing in communication with exhaust from the forward drive system and an undeployed position fully contained within the housing.

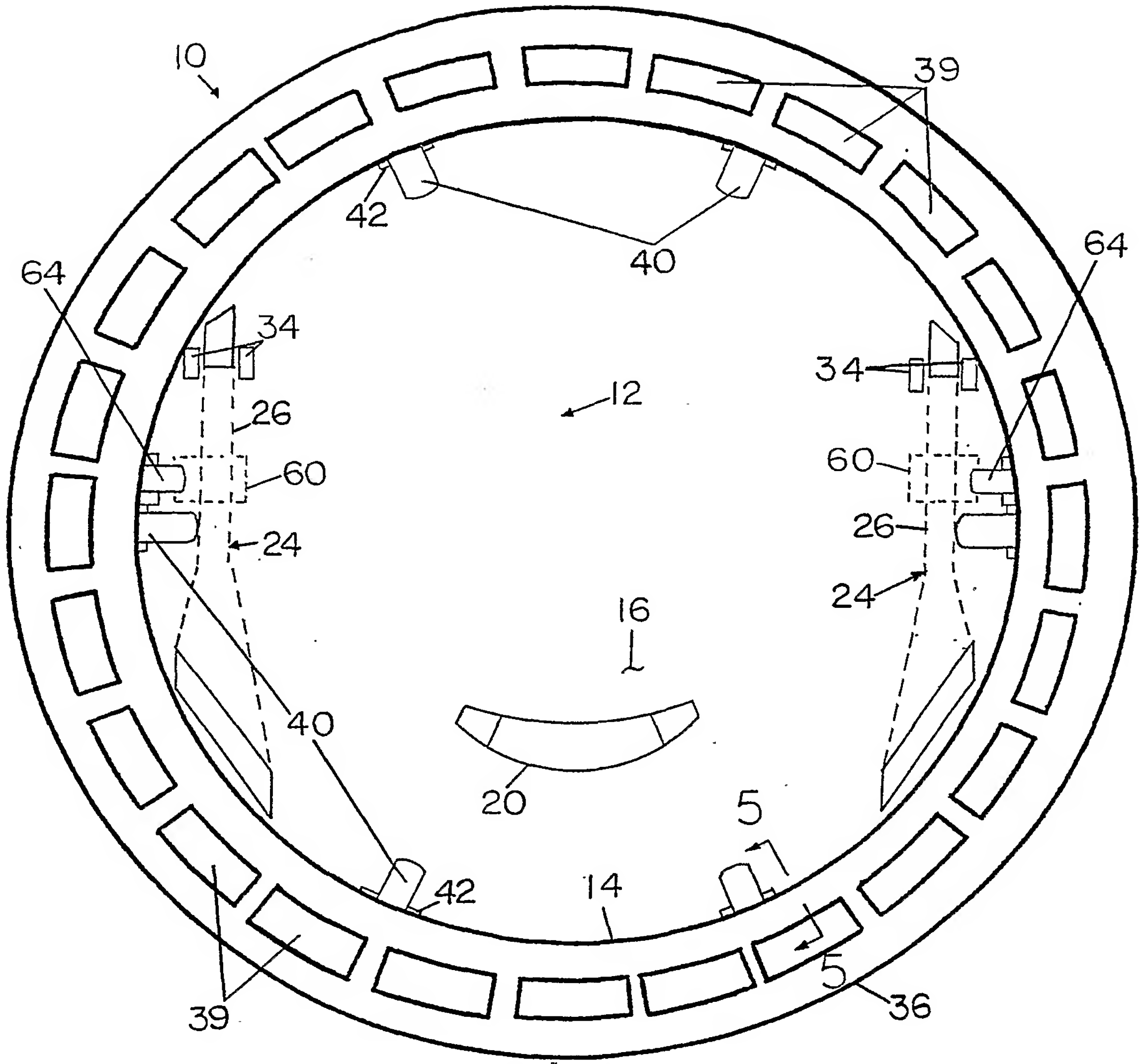
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FIG. 1

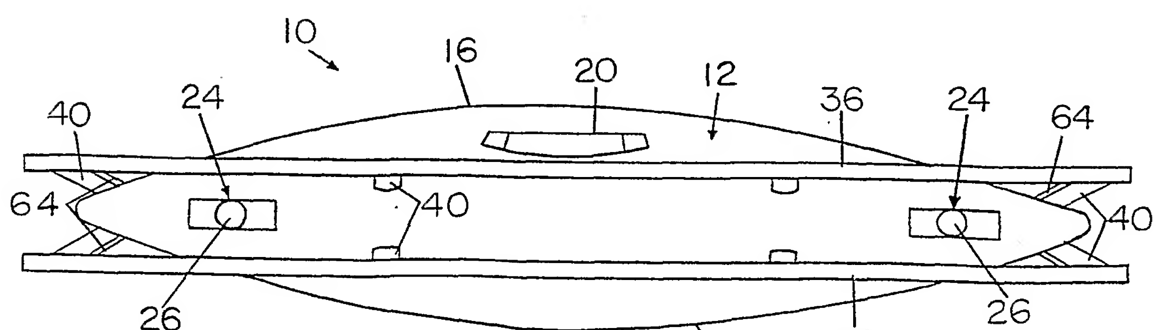
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FIG. 2

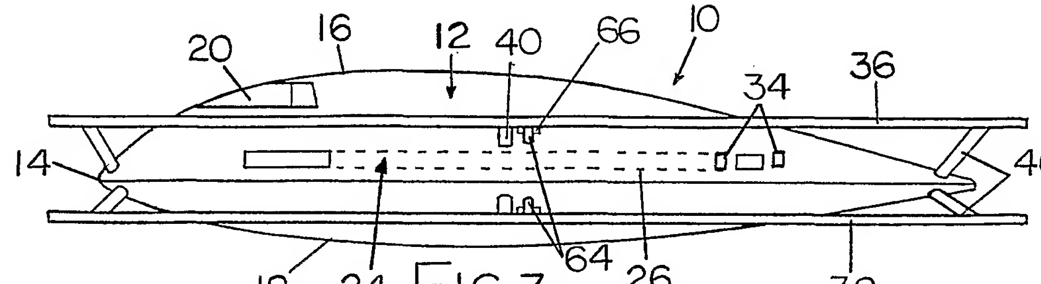
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FIG.3

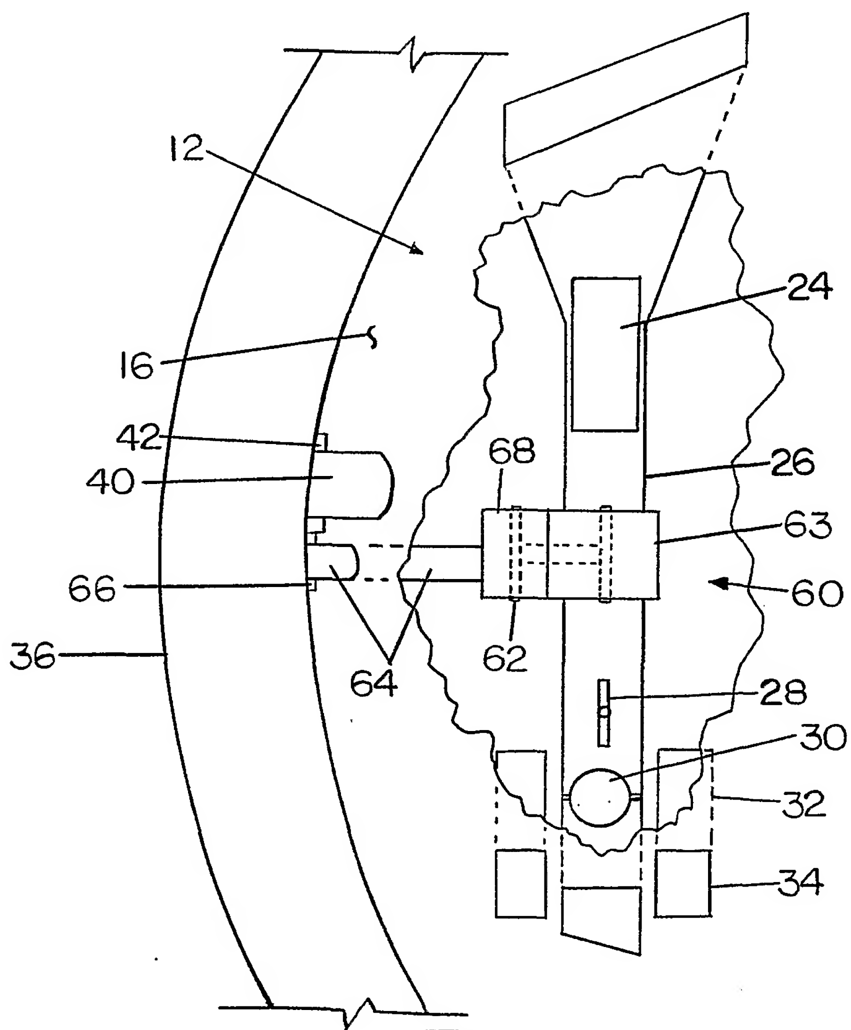
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FIG.4

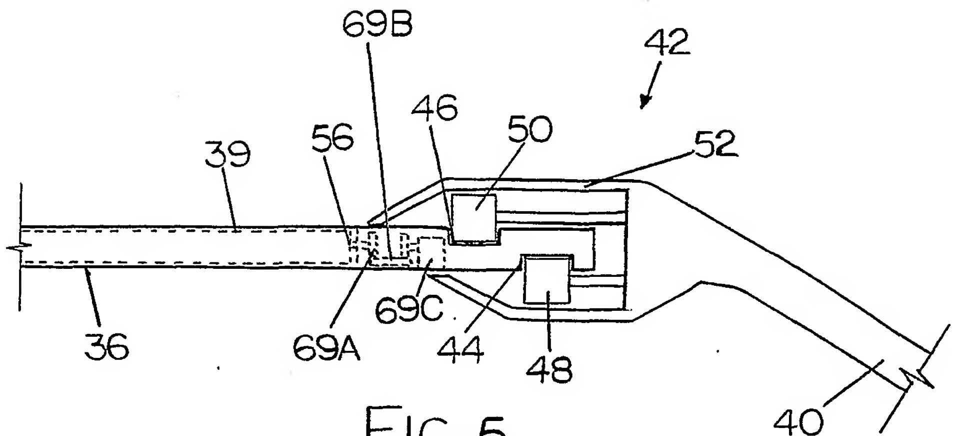

FIG. 5

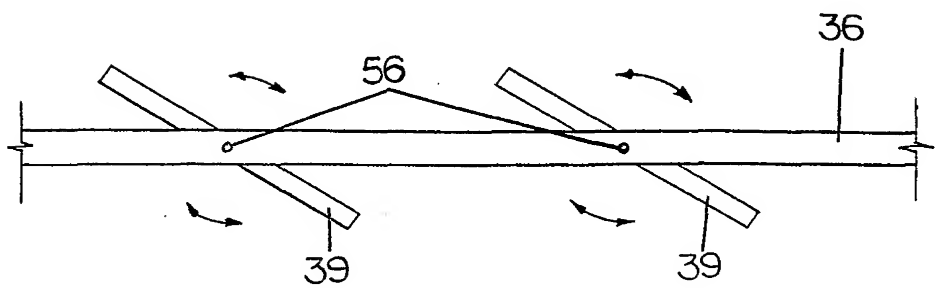

FIG. 6

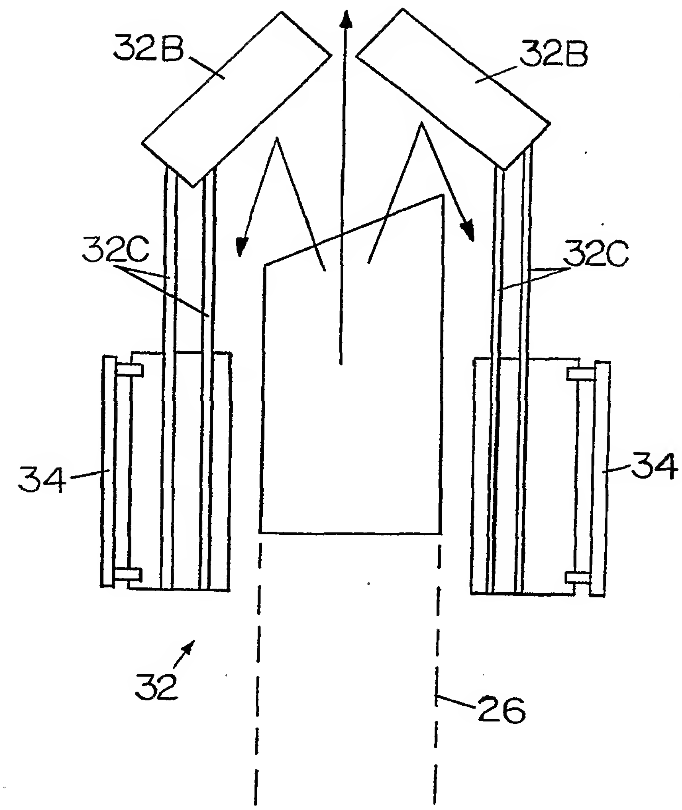

FIG. 7

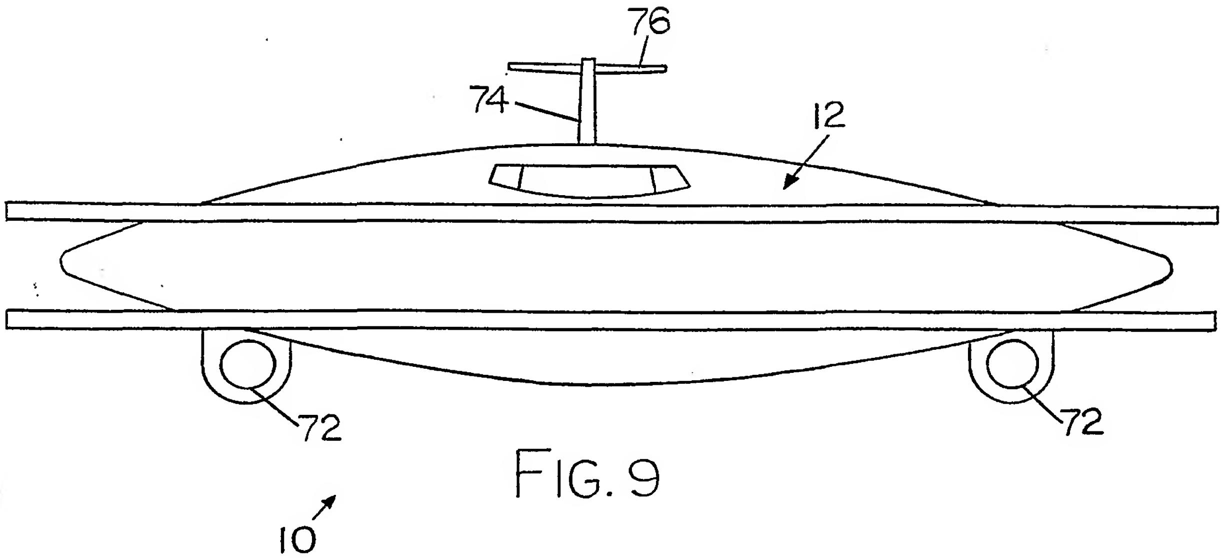

FIG. 9

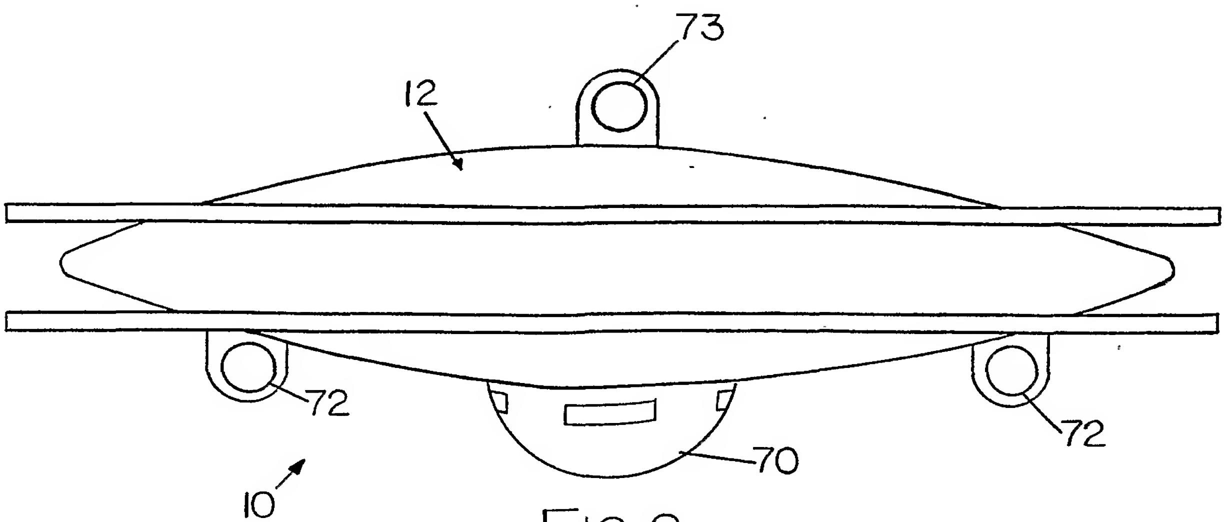

FIG. 8

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 01/00819

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B64C39/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B64C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 149 012 A (VALVERDE RENE L) 22 September 1992 (1992-09-22) column 2, line 8 - line 23 column 7, line 3 - line 15	1
X	US 5 039 031 A (VALVERDE RENE L) 13 August 1991 (1991-08-13) cited in the application the whole document	1
A	US 5 072 892 A (CARRINGTON ALFRED C) 17 December 1991 (1991-12-17) column 1, line 31 - line 60 column 3, line 35 - line 53 column 5, line 55 - line 58	1,3,9,10

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 October 2001	17/10/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Hauglustaine, H

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 213 284 A (WEBSTER STEVEN N) 25 May 1993 (1993-05-25) column 6, line 50 -column 7, line 9 ---	1,3,8-10
A	US 4 773 618 A (OW GORDON J W) 27 September 1988 (1988-09-27) column 5, line 59 -column 6, line 6 column 8, line 2 - line 11 -----	1,3,4,9, 10,15

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int' onal Application No
PCT/CA 01/00819

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 5149012	A	22-09-1992	NONE		
US 5039031	A	13-08-1991	EP	0505509 A1	30-09-1992
			JP	5501095 T	04-03-1993
			WO	9115400 A1	17-10-1991
US 5072892	A	17-12-1991	NONE		
US 5213284	A	25-05-1993	NONE		
US 4773618	A	27-09-1988	NONE		